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Koninklijke Philips Electronics N.V.
Groenewoudseweg 1
5621 BA Eindhoven
PAYS-BAS

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Picture display device with reduced deflection power

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Picture display device with reduced deflection power

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BACKGROUND OF THE INVENTION

The invention relates to a picture display device comprising :

- a cathode ray tube comprising an elongated display screen with a long axis and a short axis, a cone portion with varying cross-section, a neck portion comprising means for generating three in-line electron beams, the in-line plane being parallel to the long axis of the display screen, and
- a deflection system mounted on said cone portion for generating electromagnetic fields for deflecting said electron beam(s), wherein the line scanning direction is parallel to the long axis of the display screen.

A picture display device as described above is known from US patent nr. 5,962,964. The CRT of said known display device comprises a cone portion whose cross section varies gradually from a circular shape at the neck end of the cone portion to a substantially rectangular shape at the display screen end of the cone portion.

The deflection system can therefore be positioned closer to the envelope of the electron beam(s) than within CRTs whose cone have circular cross sections. Magnetic losses are thereby reduced and as a result less deflection power is needed.

According to US patent nr. 5,962,964, deflection power consumption reductions between 17% and 25% can be achieved.

There is nevertheless a wish to further reduce the power consumption of the deflection system.

SUMMARY OF THE INVENTION

It is an object of the invention to provide a picture display device with further reduction of the deflection power.

To this end, in accordance with an aspect of the invention, the picture display device is characterised in that in cross-section the outer circumference of cone portion comprises a first section, near the neck portion, having a long axis and a short axis transverse to each other, wherein the short axis is parallel to the long axis of the display screen, the outer

circumference of the cone portion having a second section, further away from the neck, having a long axis and a short axis transverse to each other, wherein the short axis is parallel to the short axis of the display screen.

5 The present invention enables a further reduction of deflection power.

10 In known designs the cone portion shows a cross-section in which the aspect ratio, i.e. the ratio between the x- and y-dimensions, wherein the x-direction is parallel to the long axis of the display screen, which is also parallel to the line scanning direction, changes gradually from the aspect ratio of the neck (usually 1), to the aspect ratio of the display
15 screen (e.g. 4/3 or 16/9). In the cathode ray tubes in accordance with the invention a part of the cone portion near the neck has a rectangular cross-section of which the long axis and short axis are oriented such that the long axis is not parallel to the long axis of the display screen, but the short axis is parallel to the long axis of the display screen. Although it seems strange and counterintuitive to start the cone portion with a first section which actually has
20 the 'wrong orientation', the inventors have realized that by reversing the long and short axis, for a first section of the cone portion, near the neck portion, i.e. for the part in which the initial deflection of the electron beams is generated by the deflection, deflection power can be further reduced. The invention makes it possible to bring the line deflection coils on average closer to the deflected electron beams there where the initial deflection takes place. A major
25 part of the deflection power is needed for the line deflection coils. The possible reduction in line deflection power carries a cost, namely the cost of the a somewhat increased distance between the deflected electron beams and the frame deflection coils thereby increasing the required frame deflection power, but in total, a reduction of deflection power is obtainable.

25 Preferably, the minimum value of the aspect ratio between the outer dimension of the cone portion along a direction parallel to the long axis of the display screen and outer dimension perpendicular to the long axis of the display screen is between 0.60 and 0.95, most preferably between 0.70 and 0.90.

30 The aspect ratio of the screen itself is e.g. 4/3 or 16/9. The cone portion has a part, near the neck portion for which said aspect ratio is smaller than 1 and the aspect ratio of the cone portion changes, going from the neck towards the screen, into a value larger than 1, and near the display screen attains a value of or near the aspect ratio of the screen (e.g. 4/3 or 16/9, depending on the design of the screen of the cathode ray tube).

The small aspect ratio smaller than 0.70 and even more so for values smaller than

the designs of deflection units and deflection coils. Values of larger than 0.95 will give a relatively small positive effect.

The economy of deflection power (a further reduction of several percent of the deflection power, in comparison to prior art is possible) may be used advantageously to increase the maximum deflection angle of the electron beam(s). In preferred embodiments, maximum deflection angles larger than or equal to 120° are being realised. This is useful to build more slim CRTs.

BRIEF DESCRIPTION OF THE DRAWINGS

These and further aspects of the invention will be explained in greater detail by way of example and with reference to the accompanying drawings, in which:

FIG.1 is a sectional view of a picture display device according to an embodiment of the invention;

FIG.2 is a sectional view of the display window;

FIG.3 illustrates the outer circumferences of a cone portion of a CRT for or of a display device in accordance with the invention;

Fig. 4 illustrates in graphical form the aspect ratio and an angle as function of z .

Fig. 5 illustrates the aspect ratio as a function of z for several embodiments of the invention.

The Figures are not drawn to scale. In general, like reference numerals refer to like parts.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

A picture display device according to a preferred embodiment of the invention is shown in FIG.1.

It comprises a cathode ray tube 1, which includes a display window 2, a cone portion 3, and a neck portion 4 (or neck as it is called hereinbelow). In the neck 4, there is a means 5 for generating three in-line electron beams 6, the in-line plane being parallel to the long axis of the display screen. A means for generating an electron beam is usually an electron gun. Such designs are standard designs. The inner surface of the display window 2 comprises a large number of phosphor elements which form a display screen 8. When one or more of the electron beams 6 hit phosphor elements, the latter become phosphorescent,

thereby creating a visible spot on the display screen 8. In the undeflected state, the middle one of the electron beams 6 substantially coincides with the tube axis 7. The direction of the tube axis is hereinbelow denoted by the z-direction. The direction along the long axis of the display screen is denoted by the x-direction, the direction along the short axis of the display screen by the y-direction. The line scanning direction (i.e. the direction in which scanning with the highest frequency takes place is parallel to the long axis (the x-direction) of the display screen. On its way to the display screen 8, the electron beams 6 are deflected by means of a deflection system 9 covering a part 3a of the cone portion 3. It is in particular this part 3a of the outer contour that the invention relates to. Said deflection system 9 comprises a line deflection subsystem 12 and a frame deflection subsystem 13, in order to create a two-dimensional picture on the display screen 8. In this exemplary embodiment, the deflection system 9 is made up of sets of coils, one set for the line deflection subsystem 12 and another set for the frame deflection subsystem 13. The outer circumference of the cone portion comprises a first section I near the neck and a second portion II further away from the neck, more towards the screen.

Plane 11 is the so-called deflection plane. The deflection plane is the plane from which the deflected beams seem to originate, as is schematically shown for deflected beam 10. The figure also indicates the x-direction, i.e. the direction along the long axis of the display screen and the z-direction. The z-coordinate of the deflection plane is usually (and hereinbelow) taken to be zero, with positive values of z being closer to the display screen.

As can be seen from FIG. 2, the display screen (8) has an elongated shape with two perpendicular axes of symmetry : a long axis (21) whose length is L_{scr} and a short axis (22) whose length is S_{scr} . In order to quantify the amount of elongation of the display screen (8), the aspect ratio of the display screen (8) is defined as $A_{scr} = L_{scr}/S_{scr}$.

We also define the maximum deflection angle as being the angle θ between the tube axis (7) and the deflected electron beam (10) when the electron beam is deflected so as to hit a point on the display screen (8) which is the furthest away from the intersection between the tube axis (7) and the display screen (8).

The following relation holds

$$\tan(\theta) = A_{scr}$$

Depending on the design A_{scr} is usually $4/3$ (1.333) or $16/9$ (1.78)

The maximum deflection angle is the angle between the tube axis and the deflected electron beam when the electron beam is deflected so as to hit a point on the display screen which is the furthest away from the intersection between the tube axis and the display screen.

circumference of the cone portion is either circular (i.e. having an aspect ratio of 1, in which case the inside of the deflection unit is also substantially circular) or changes gradually from circular (aspect ratio 1) to rectangular in accordance with the aspect ratio of the display screen.

5 An example of such a design is known from US patent nr. 5,962,964. The CRT of said known display device comprises a cone portion whose cross section varies gradually from a circular shape at the neck end of the cone portion to a rectangular shape at the display screen end of the cone portion. This reduces the power dissipation.

10 In a picture display device in accordance with the invention the aspect ratio of the cone portion is for a first part of the cone portion, i.e. a part near the neck, less than 1, changing into a value larger than 1 as a function of z .

15 Figure 3 illustrates such a design. The figure shows as a function of z the outer circumference of the cone portion. Each outer circumference comprises in this example a substantially horizontal part 31 (i.e. extending along the x - or scanning direction) with a large radius of curvature, a substantially vertical part 32 (i.e. extending along the y or frame direction) with a large radius of curvature, and a corner part 33 with a centre of curvature 34. The smallest cross-section shown is the part nearest the neck portion which in this example is circular, so that the first cross-section is circular, the next smallest one is near the neck portion, the largest ones are nearest the screen, i.e. for the largest values of z . For a number of
20 cross-sections the radius of curvature of the corner part 34 is shown, where the angle θ_{\max} which is the angle formed by a line between the centre (i.e. $x,y=0,0$) and the largest radius of the cross-section (i.e. the largest value of x^2+y^2 for that particular z -value) is indicated.

25 As can be seen for small values of z , i.e. in the figure 3 the smallest, innermost cross sections, corresponding to those parts of the cone nearest to the neck portion, the y dimension is larger than the x -dimension, for instance for the cross-section to which the numbers 31 to 34 are attached, the $x:y$ ratio is 18:22. This means that the outer circumference of the cone portion is larger in the y direction than in the x -direction, i.e. the cone is elongated in the frame direction. For the largest cross-sections (highest values of z , the $x:y$ aspect ratio is larger 1, for instance for the largest cross-section shown here the x -dimension
30 is 60, while the y dimension is 56. This change in form of the outer circumference from a form elongated in the frame direction (near the neck portion), to a form elongated in the scanning direction (towards the screen) enables a reduction of the power dissipation. The line scanning deflection coils can be brought closer to the electron beams in the most deflected

position. Lines 36 shown the positions of the deflected beams in maximum deflection, respectively for 6% overscan. In this preferred embodiment the neck portion itself is circular.

The angle θ_{\max} (i.e. the angle that the arrows form with the x-axis) changes from an angle well over 45 degrees (near the neck portion), and in this example starting with a value of 90 degrees, to an angle below 45 degrees, approaching the angle corresponding to the arctangent of the aspect ratio of the display screen near the display screen (A_{scr}).

The following mathematical calculation method (without being restricted to such a calculation method) can be used to calculate the outer contour. It is assumed that the radii of curvature of parts 31, 32 and 34 remain the same throughout the cone (but usually not equal to each other, since the radii of curvature of parts 31 and 32 is much larger than that of part 33). The radius of curvature of part 33, the corner part is set to be equal to the radius of curvature of the neck part, to obtain a smooth transition from the neck part to the cone portion. A smooth transition increases the strength of the cone. For each point on the line 36, i.e. the position of the deflected beams, the locations of the centre points 34 are found by finding a line perpendicular to the round part 34, through line 36 and making an angle of 30° with the x-axis. In the figure this is indicated by $\alpha=30^\circ$. Using this mathematical construction (but many more are possible, for instance the radii of curvature may be made z-dependent, or the corner may be chosen to slightly depart from a purely circular arc form) device within the concept of the invention have an angle α which is smaller than 45° . When the angle between the x-axis and a line through the centre points 34 and the line 36 is less than 45° in particular approximately 30° , the distance in the x-direction between the outer contour and the line 36 can be made small, enabling the line deflection coils to be brought close to the electron beams, reducing the deflection power, be it at a cost of increasing the distance along the y-direction.

For the example schematically shown in figure 3, figure 4 shows as a function of z (in mm, where $z=0$ corresponds to the z-value of deflection plane 11 (see figure 1)), the aspect ratio A of the cross-section of the cone (in percentage, i.e. 100% is an aspect ratio of 1) and the angle θ_{\max} (in degrees). As can be seen the aspect ratio changes from 1 to a values smaller than 1 in a first section I to a value larger than 1 in a second section II. The angle θ_{\max} changes from an angle larger than 45 degrees (roughly 90 degrees in this preferred embodiment) to an angle smaller than 45 degrees. The first section I and the second section II are indicated in figure 4, the vertical line indicating the border between the first and second

Figure 5 shows for various angles of α as indicated in the figure, the aspect ratio as a function of z , where $z=0$ corresponds to the deflection plane, negative values of z indicate point closer to the neck portion, and positive values of z are nearer to the screen. All of these examples fall within the framework of the invention, since in all of the examples the aspect ratio (the x/y ratio) changes from a value smaller than unity for a part (I) near the neck, to a value above unity with increasing z (in part II), i.e. getting closer to the screen. It is preferred, however, that the aspect ratio in the first part (I) has a minimum value of between about 0.70 and about 0.90, in this figure corresponding to an angle between 30 and 15 degrees. Too small a minimum value of the aspect ratio would require relatively large changes in design of the deflection unit, and contour of the cone, whereas a value close to one would give a relatively small positive effect. Preferably the border between the parts I and II lies near the deflection plane, near being within 30 mm (seen in the z -direction) from the deflection plane.

It will be clear many variations are possible that fall within the scope of the invention. The protective scope of the invention is not limited to the embodiments described.

In short the invention may be described as follows:

A picture display device comprises a cathode ray tube (1) with an elongated display screen (8) and a deflection system (9) for deflecting electron beams. The display screen (8) is substantially rectangular with a long (21,x) and a short (22,y) axis. The line scanning direction is parallel to the long axis of the display screen. The cathode ray tube comprises a neck portion and between the screen and the neck portion a cone portion. This cone (3, 3a) portion has an aspect ratio (ratio of x and y dimension), which is near the neck below unity (aspect ratio < 1) and changes to above unity (aspect ratio > 1) further away from the neck, i.e. closer to the screen.

The invention resides in each and every novel characteristic feature and each and every combination of characteristic features. Reference numerals in the claims do not limit their protective scope. Use of the verb "to comprise" and its conjugations does not exclude the presence of elements other than those stated in the claims. Use of the article "a" or "an" preceding an element does not exclude the presence of a plurality of such elements. The means for generating three in-line electron beams may for instance be constituted by an electron gun in which (as in standard designs) three electron beams are generated but electrodes are common, or by three separate electron guns. However, other means for generating electron beams may be used, departing from the standard designs.

CLAIMS:

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1. A picture display device comprising

- a cathode ray tube comprising an elongated display screen with a long axis and a short axis, a cone portion whose cross section has an elongated shape with a long axis and a short axis, a neck portion comprising means for generating three in-line electron beams, the in-line plane being parallel to the long axis of the display screen and
- a deflection system mounted on said cone portion for generating electromagnetic fields for deflecting said electron beams, wherein the line scanning direction is parallel to the long axis of the display screen,

characterized in that in cross-section the outer circumference of the cone portion comprises a first section, near the neck portion, having a long axis and a short axis transverse to each other, wherein the short axis is parallel to the long axis of the display screen (aspect ratio <1), the outer circumference of the cone portion having a second section, further away from the neck, having a long axis and a short axis transverse to each other, wherein the short axis is parallel to the short axis of the display screen (aspect ratio >1).

2. A picture display device as claimed in claim 1, characterized in that an angle formed by a line between the centre and the largest radius of the cross-section is larger than 45 degrees for a part of the cone portion near the neck portion, said angle changing to a value less than 45 degrees for a part of the cone portion nearer to the display screen.

3. Display device as claimed in claim 1, characterized in that for said first section the minimum value of the aspect ratio between the outer dimension of the cone portion along a direction parallel to the long axis of the display screen and outer dimension perpendicular to the long axis of the display screen is between 0.60 and 0.95, preferably between 0.70 and 0.90.

4. Display device as claimed in claim 2, characterized in that the angle changes from an angle larger than 45 degrees in the first section to an angle smaller than 45 degrees in the second section.

ABSTRACT:

A picture display device comprises a cathode ray tube (1) with an elongated display screen (8) and a deflection system (9) for deflecting electron beams. The display screen is substantially rectangular with a long and a short axis. The line scanning direction is parallel to the long axis of the display screen. The cathode ray tube comprises a neck portion and between the screen and the neck portion a cone portion (3, 3a). This cone portion has an aspect ratio (ratio of x and y dimension, x/y ratio), which is near the neck below unity and changes to above unity closer to the screen as a function of z.

Fig. 5

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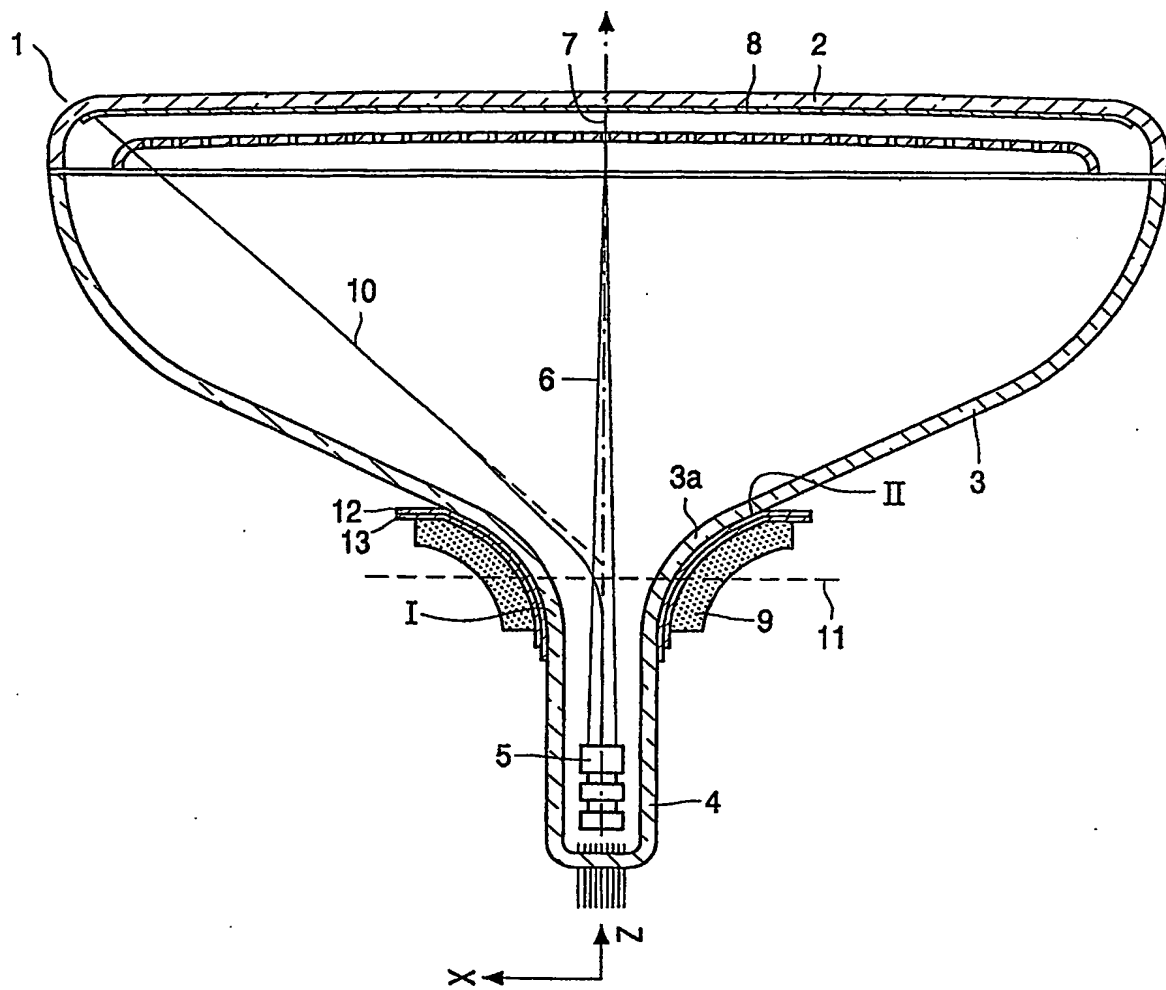


FIG. 1

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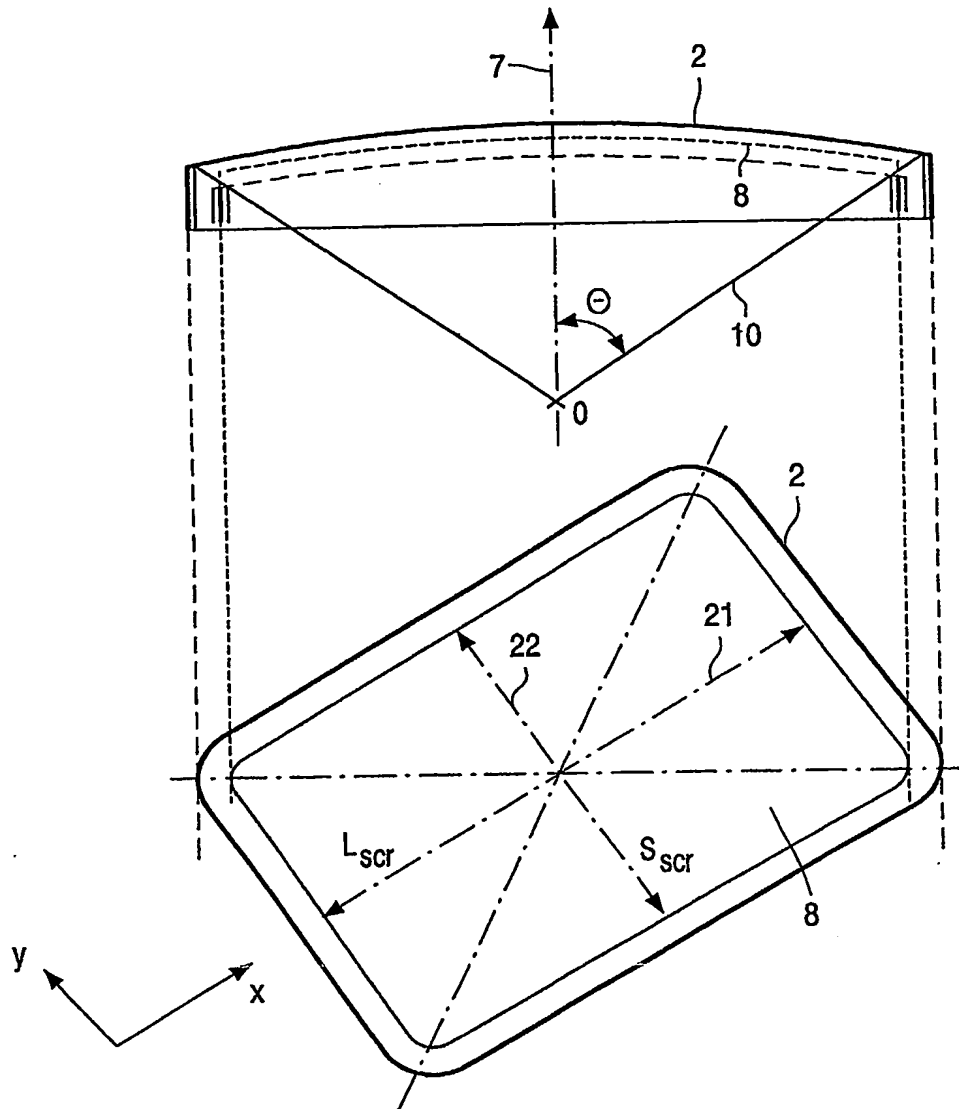


FIG. 2

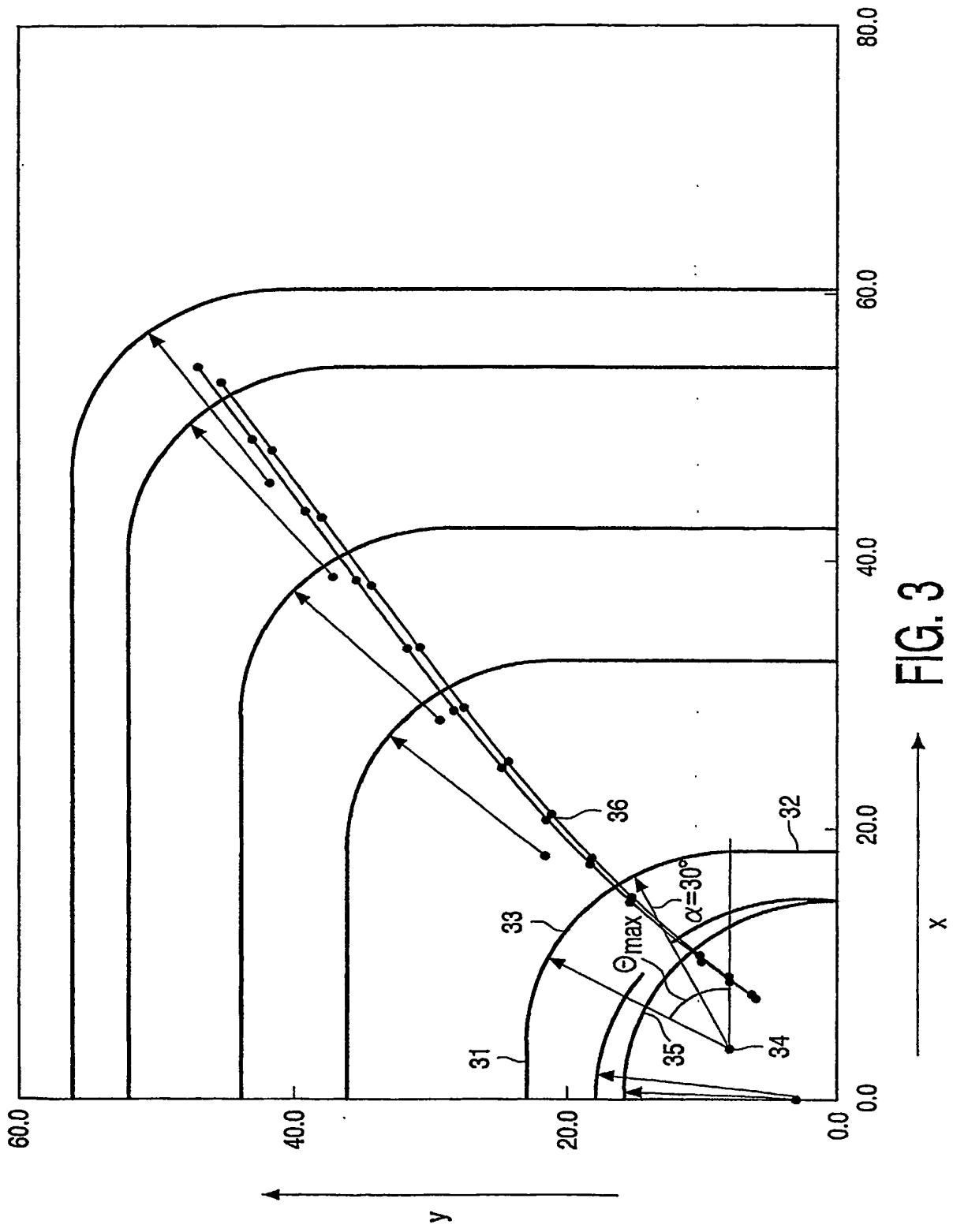


FIG. 3

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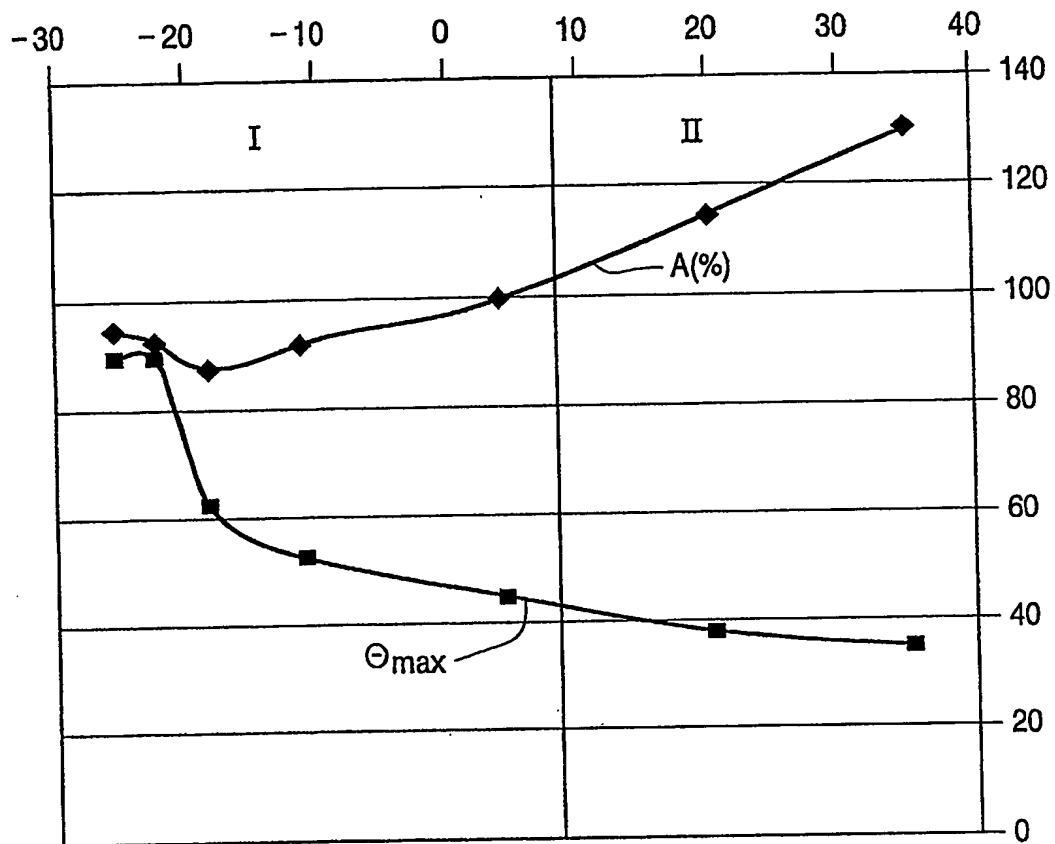


FIG. 4

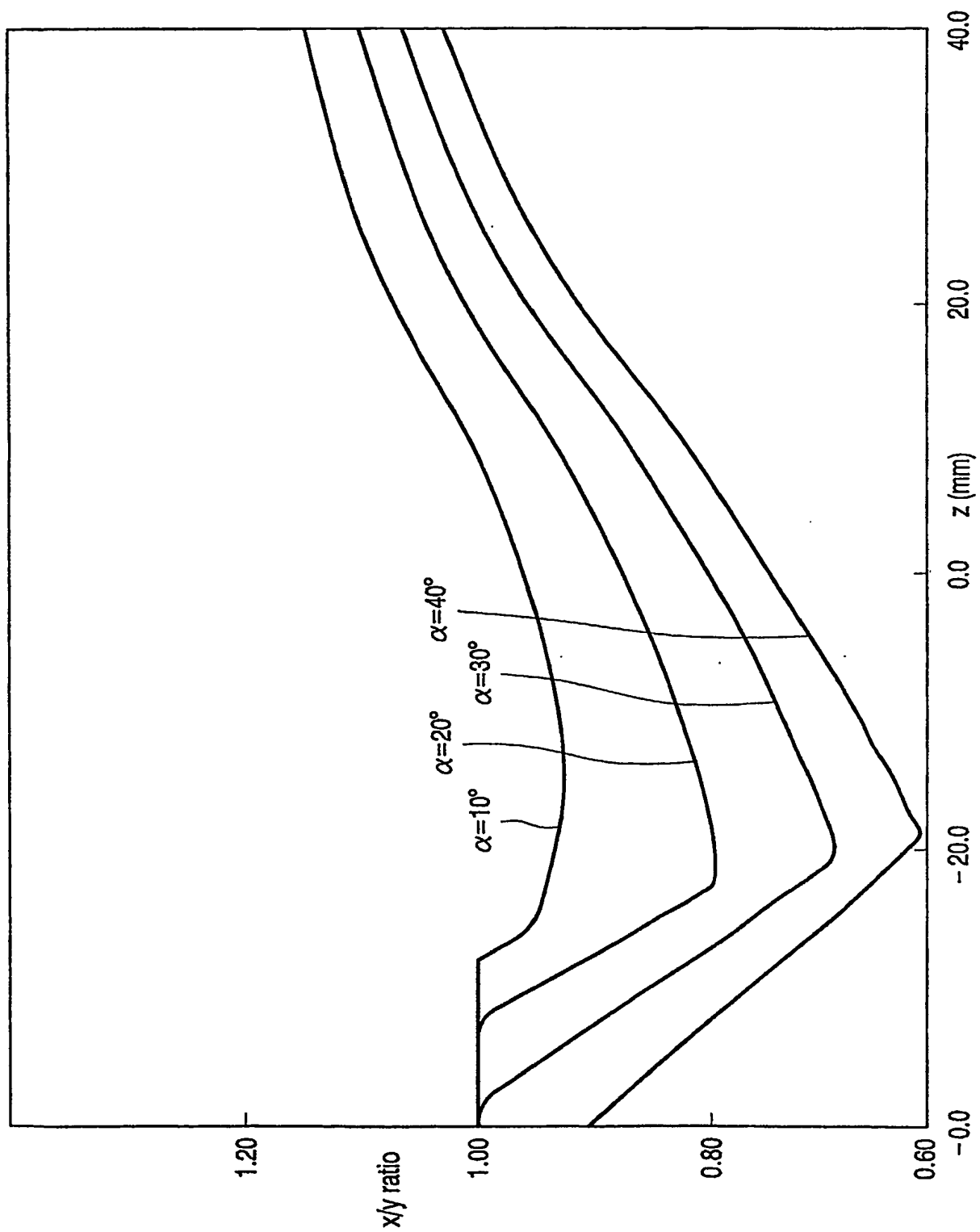


FIG. 5